Mega-Node Sr.

KAY ELECTRIC CO.

Model 2603
S/N 7558
SFC 40586

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Figure 1. **MEGA-NODE SR.**

SECTION I
GENERAL DESCRIPTION

A. APPLICATION.

The **MEGA-NODE SR.** (NOise dioDE Senior) is a calibrated random noise source, providing output over a wide frequency (10 to 3000 Mc) and power range. It may be used for the rapid measurement of receiver gain or noise figure (without tedious calculation of effective bandwidth) and for the indirect calibration of standard signal sources. At the lower end of the frequency range, noise figure may be obtained directly from the meter of the **MEGA-NODE SR.**

B. DESCRIPTION.

The **MEGA-NODE SR.** employs a coaxial-type noise diode with a tungsten filament as a temperature-limited fluctuation noise generator. The plate voltage is regulated to extend diode tube life. The diode filament is dc, supplied from a selenium bridge rectifier and a voltage-regulated source to completely eliminate low frequency modulation.

The diode plate current, which is proportional to noise power output, is adjusted by a level control on the front panel. This current is indicated on a front-panel meter, linearly calibrated in db noise figure. An output cut-off control is included for use in obtaining readings proportional to the noise power output of the circuit under test. To prolong the life of the noise diode, an automatic cut-off is incorporated to limit operation at high currents. After cut-off, the instrument may be returned to operating condition by pressing the operate control on the front panel.

A special terminating network, requiring no tuning, is included to assure low VSWR at the output connector. For very accurate determinations at higher frequencies, a *Mega-Chart* of impedance at the output is included with each instrument. A chart on the meter face also is included for correcting transit time effects in the diode at high frequencies.

C. SPECIFICATIONS.

Frequency Range: 10 Mc to 3000 Mc.

Output Impedance: Nom. 50 ohms into type N connector.

Noise Figure Range: 0 to 20 db.

Meter Calibration: Linear in db noise figure. Logarithmic in d-c ma.

Tube: Eclipse Pioneer type TT-1 diode.

Power Supply: Input approximately 200 watts, 117 volts (±10%), 60 cps a-c. B^+ electronically regulated.

Dimensions: 9¾" x 19½" x 17¼".

Weight: 56 lbs.

D. EQUIPMENT SUPPLIED.

1. **MEGA-NODE SR.**, complete with tubes, TT-1 diode and cabinet.
2. *Mega-Chart* for more accurate output impedance determinations.
3. Instruction Book.

E. ADDITIONAL EQUIPMENT REQUIRED.

1. Power level measuring device (square law r-f voltmeter, thermocouple power meter or bolometer power meter).

   or

   A-C voltmeter (whose law is unknown) plus a 3 db pad with a switching arrangement to select the pad as desired.

   or

   Any a-c voltmeter and detector, for relative measurements of noise.

   or

   A vacuum tube voltmeter and log-log graph paper for performing noise figure measurements at or near maximum output capabilities of the **MEGA-NODE SR.**

2. Low noise amplifier, where device under test has insufficient output to deflect a power level indicator.

3. Hum filter (60 or 120 cps), bridge-type.

4. Interconnecting cables, shielded where low levels are involved. (RG-8/U is recommended.)

SECTION II
INSTALLATION

A. GENERAL.

The **MEGA-NODE SR.** is designed for table-top operation. No special installation problems should be encountered. However, as a guide the following should be of aid in selecting a permanent location for the instrument:

1. Select a location where the equipment will not be subjected to excessive heat, moisture, or mechanical disturbance.

2. A blower is mounted on the chassis for cooling the noise diode. Be sure there is sufficient air space around the unit for adequate air circulation.

3. The unit requires connections to a 117V, 60 cps, power source and to the device under test. Cabling to the device under test must be as short as possible and properly terminated. (RG-8/U transmission line is recommended.)

B. INTERCONNECTION DATA.

The type of output measuring device and other auxiliary equipment employed will determine the method of interconnection. It is advised that before selecting a method of measurement, the sections on operation techniques and noise measurement theory first be reviewed. (Sections III and IV.)

1. **POWER LEVEL METER CONNECTIONS.** *Figure 2* illustrates the method of connecting the **MEGA-NODE SR.** and the device under test to a power level measuring instrument. If the device under test is a receiver, the connection should be made at a point following the i-f amplifier stages but before the limiter, if on an FM receiver, or second detector, if on an AM receiver.

The amplifier shown in *Figure 2* may be omitted if the receiver's i-f amplifier output is sufficient to operate the power level meter. In using an amplifier following the receiver under test, it is important that the amplifier respond to the i-f frequency of the receiver under test and have a flat band-pass capability to include the bandwidth of the receiver's i-f amplifier.

2. **AC VOLTMETER AND FIXED PAD CONNECTIONS.** When a power level meter is unavailable, the fixed pad method may be employed for noise figure measurements; this method requires any available type of a-c voltmeter as an indicating device (the voltmeter law is not significant in this method). Connect the equipment as shown in *Figure 3*.

In designing the attenuator pad and setting-up the switching arrangement, the terminating impedance of the amplifier must be considered. In addition, the band-pass characteristics of the attenuator must be flat over the entire bandwidth of the device under test.

In this method, the output meter is connected following a detector circuit. Therefore, any hum (due to insufficient supply filtering or stray fields) present in the output of the receiver or amplifier will be indicated on the a-c voltmeter, resulting in inaccurate noise figure measurements.

To avoid this, a bridge-type 60 or 120 cps filter (depending upon type of power supply rectifier circuit) should be employed; connect as shown in *Figure 3*.

3. **A-C VOLTMETER CONNECTIONS (RELATIVE NOISE MEASUREMENT).** This method, as shown in *Figure 4*, while not useful in determining noise figure, permits relative measurements of noise for comparison of various circuit changes, etc. As in the fixed pad method, a detector and hum filter are employed.

4. **LOG-LOG GRAPHICAL METHOD CONNECTIONS.** This method is recommended for noise figure measurements where the output capabilities of the **MEGA-NODE SR.** are less than the minimum requirements for the preceding methods.

When employing the log-log graphical method, the **MEGA-NODE SR.** output should be connected to the input of the device under test and the output connected to a diode-type detector. If the device under test is an AM receiver, the receiver's second detector may be used, providing it is a diode type. A d-c vacuum tube voltmeter should be connected across the diode's load resistor to read the d-c output of the detector. A detailed operating procedure for the log-log method is included in Section III.

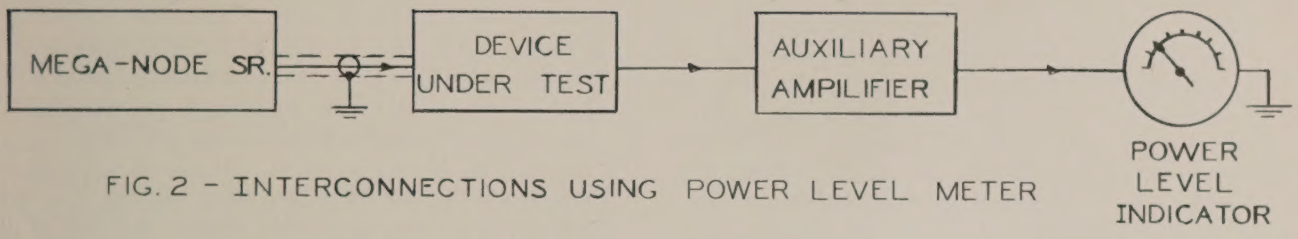


FIG. 2 - INTERCONNECTIONS USING POWER LEVEL METER

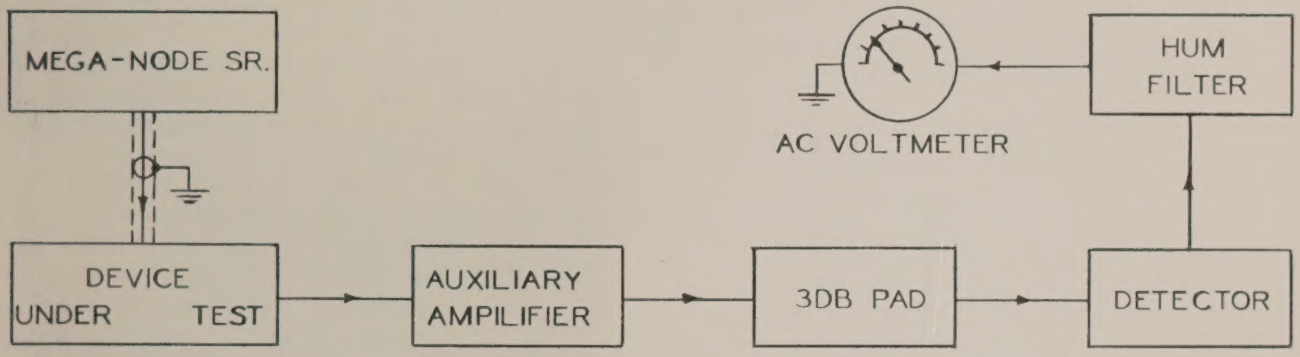


FIG. 3 - INTERCONNECTIONS USING AC VOLTMETER (FOR UNKNOWN LAW)

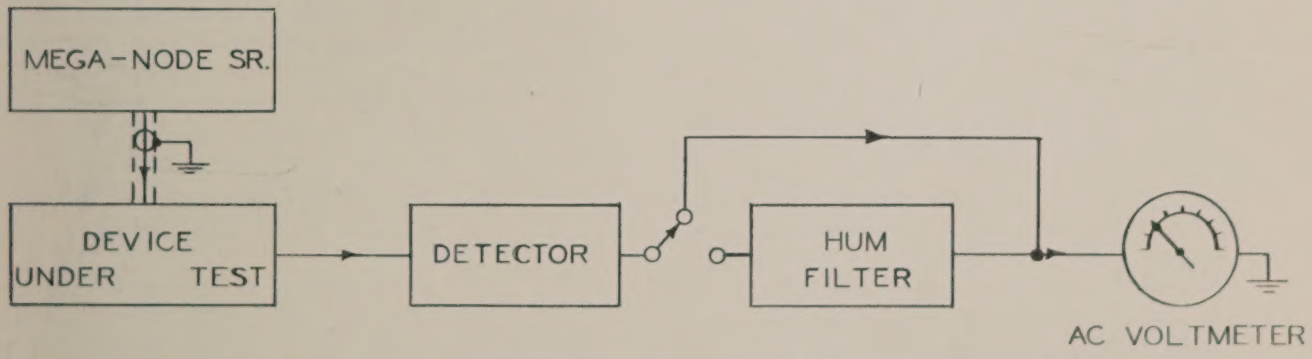


FIG. 4 - INTERCONNECTIONS FOR RELATIVE NOISE MEASUREMENTS

SECTION III
OPERATION

A. DESCRIPTION OF CONTROLS.

The following is a brief description of the **MEGA-NODE SR.** operational controls. Detailed instructions for their use are contained later in this section. (All internal controls and adjustments are described in the Maintenance Sections.)

1. POWER ON-OFF SWITCH *(S-1)*. This toggle switch determines the on-off condition of the instrument. When this switch is in the OFF position, all a-c power to the equipment is removed.

2. OPERATE SWITCH *(S-2)*. This momentary contact push-button type switch, when depressed, places the **MEGA-NODE SR.** in operation. Once depressed, this switch may be released, and the instrument will continue to operate until an internal thermal cut-out relay *(K-2)* opens the primary circuit, or the OUTPUT INDICATOR switch *(S-4)* is rotated to the CUTOFF position. The NOISE output indicator lights when this switch is depressed. The blower will be heard going into operation.

3. OUTPUT INDICATOR SWITCH *(S-4)*. This rotary selector switch provides the following functions: In the READ METER position, the meter reads directly in db noise figure or diode plate current. In the CUTOFF position, all power is removed, thereby permitting a noise reading to be taken without the **MEGA-NODE SR.** in operation. When the OUTPUT INDICATOR switch is in the ADD 10 DB position, the meter reads 10 db under the actual noise output. (Full scale current is 100 ma in this position.)

4. COARSE NOISE OUTPUT ADJUSTMENT POTENTIOMETER *(R-8)*. The setting of this control determines the level of the noise output of the **MEGA-NODE SR.** Rotating the control clockwise advances the output. The panel meter provides output indication.

5. FINE NOISE OUTPUT ADJUSTMENT POTENTIOMETER *(R-10)*. This control is used in conjunction with the COARSE NOISE OUTPUT ADJUSTMENT potentiometer as a vernier adjustment.

B. NOISE FIGURE MEASUREMENT TECHNIQUES.

The following is a detailed description of the various methods used in performing noise figure measurements with the **MEGA-NODE SR.** It should be noted that while method #1 and #2 are comparatively simple to perform, it may be necessary to resort to method #4 (**LOG-LOG METHOD OF EVALUATING NOISE FIGURE**) if the device under test has a noise figure value above 20 db. In employing the first two methods (3 db power increase) the device under test and external amplifier must be capable of supplying a power output of 3 db above the internal noise level without exceeding maximum output capabilities of the last stages of the device under test and the auxiliary amplifier.

1. **METHOD USING CALIBRATED POWER LEVEL METER** *(Refer to Figure 2)*. The output meter employed must be a device capable of indicating random noise power ratios. For best accuracy, it is desirable to use a meter corresponding to RMS voltage or current values. It is also best to first determine the linearity of the indicator and auxiliary equipment; this may be accomplished in the following manner:

a. Connect the equipment as shown in *Figure 2*; then, with the **MEGA-NODE SR.** introduce a noise into the device under test, to provide an output of at least 8 db above the internal noise level of the unit under test. Note the resulting indication on the output meter.

b. Increase the **MEGA-NODE SR.** output 3 db as indicated on the panel meter.

c. The resulting deflection change in the output power indicating device is then a measure of the 3 db change in noise power output from the equipment under test. Note the new output meter reading.

NOTE

The preceding calibration procedure should be performed with the gain of the system reduced to the point where the operating level of the indicating device is the same as for the ensuing noise figure measurement.

After determining the calibration of the power level measuring device, the noise figure of the device under test may be established. Use the following procedure:

d. With the equipment connected as shown in *Figure 2*, adjust the gain of the auxiliary amplifier to provide an indication on the power level indicating device equal to the value noted in step *a*.

e. Place the **MEGA-NODE SR.** ON-OFF switch *(S-1)* in the ON position. Rotate the OUTPUT INDICATOR switch *(S-4)* to the READ METER position.

f. Momentarily depress the OPERATE switch *(S-2)*. Rotate the COARSE NOISE OUTPUT ADJUSTMENT potentiometer until the power level indicating device shows a 3 db increase (doubled power). If additional output is required from the **MEGA-NODE SR.**, rotate the OUTPUT INDICATOR switch to the ADD 10 DB position and again depress the OPERATE switch.

g. Note the db indication on the **MEGA-NODE SR.** meter scale (add 10 db to this reading if the OUTPUT INDICATOR switch is in the ADD 10 DB position). Correct for transit time error with the meter scale correction data or by using the chart in *Figure 5*. The result is the db noise figure of the device under test. (If the device under test is a super-heterodyne receiver, correct for error caused by image response. Refer to paragraph 5 below.)

In using the 3 db power increment method, it is obvious that only noise figure measurements up to 20 db may be read directly on the **MEGA-NODE SR.** meter scale. If, in performing a measurement, maximum output from the **MEGA-NODE SR.** is reached before a 3 db output power increment is observed, the noise figure of the device under test is above 20 db. The actual noise figure (above 20 db) may be computed from the db increase on the power level meter when the **MEGA-NODE SR.**'s maximum output is attained. For example: a power level increment of 1.76 db would indicate a noise figure of 23 db; a power level increment of 0.969 db would indicate a noise figure of 26 db. Obviously, some loss of accuracy is found when the lower increments are used.

2. **METHOD USING FIXED PAD AND AC VOLTMETER.** This method is employed when a power level indicating device is not available. In this case, any a-c voltage indicating device may be used; the accuracy of calibration of the device is insignificant. The equipment should be connected as shown in *Figure 3*. (Interconnection data is contained in Section II.) The following is the procedure for determining noise figure:

a. With the fixed pad switched out of the circuit (0 db attenuation), the **MEGA-NODE SR.** OFF, adjust the gain of the auxiliary amplifier so that the internal noise generated in the device under test provides a deflection on the a-c voltmeter. Note this meter indication.

b. Switch in the 3 db pad; place the **MEGA-NODE SR.** ON-OFF switch in the ON position; rotate the OUTPUT INDICATOR switch to the READ METER position. Momentarily depress the OPERATE switch and adjust the COARSE NOISE OUTPUT ADJUSTMENT potentiometer for an indication on the a-c voltmeter equal to the value noted in step *a* above. (If necessary for increased output, rotate the **MEGA-NODE SR.** OUTPUT INDICATOR switch to the ADD 10 DB position.)

c. Read the **MEGA-NODE SR.** panel meter. The db noise figure of the device under test is then: the **MEGA-NODE SR.** meter reading (plus 10 db if the OUTPUT INDICATOR switch is on ADD 10 DB) less the transit time correction determined by the meter chart. If the device under test is a super-heterodyne receiver, refer to paragraph 5 below.

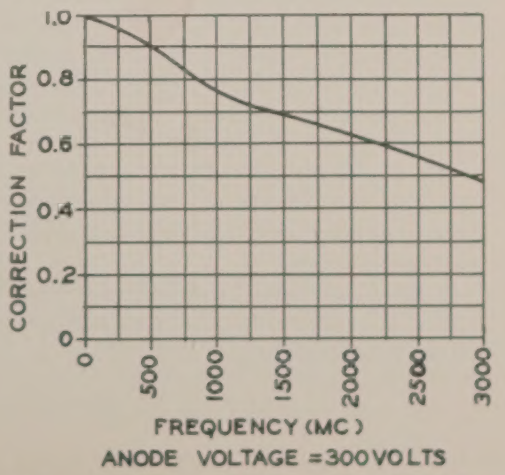


Figure 5. Transit Time Correction Chart.

3. **RELATIVE NOISE MEASUREMENTS.** Where the actual noise figure measurement is not required and relative indications of noise values will suffice, the following method may be employed:

a. With the equipment connected as shown in *Figure 4*, adjust the auxiliary amplifier gain so that the internal noise generated in the device under test results in a deflection on the a-c meter. Note this reading.

b. Place the **MEGA-NODE SR.** ON-OFF switch in the ON position; place the OUTPUT INDICATOR switch *(S-4)* in the READ METER position; momentarily depress the OPERATE switch. Adjust the noise output, with the COARSE NOISE OUTPUT ADJUSTMENT control, for an increase in the a-c voltmeter reading. (If necessary, use the ADD 10 DB position). Note the new a-c voltmeter reading. The indication on the **MEGA-NODE SR.** is then a relative indication.

After circuit changes, etc., are made in the device under test and another noise measurement is made (to show improvement, etc.), a comparative noise reading will be indicated on the **MEGA-NODE SR.** panel meter, providing the original a-c voltmeter readings are maintained.

4. **LOG-LOG METHOD OF EVALUATING NOISE FIGURE.** This method is useful where the noise figure of the device under test is comparable in value to that corresponding to the maximum output capabilities of the **MEGA-NODE SR.** It is also useful in those cases where neither an r-f voltmeter or power meter nor a 3 db attenuator pad is readily available. It involves the use of the output voltage developed by the second detector of the equipment under test (provided the detector is of the diode type) as the measured quantity, thus permitting the use of a DC type of V.T.V.M., such as is commonly available in most laboratories. The set-up of equipment is similar to that shown in *Figure 4*, with the exception that the V.T.V.M. (connected across the diode detector load resistor) replaces the hum filter and AC voltmeter shown.

The procedure is best explained by means of an illustrative example, and the various steps are given below:

a. Set up the equipment as discussed above.

b. With the **MEGA-NODE SR.** OFF and with the amplifier tube just preceding the second detector removed, measure the residual DC voltage across the detector load resistor. This voltage is caused by combination of "contact potential" and electron initial emission velocities, and its value is to be subtracted from all subsequent voltage readings prior to plotting them. Let us say this voltage reading is 0.3 volts.

c. Replace the amplifier tube removed above, and with the **MEGA-NODE SR.** still OFF and amplification provided if necessary, read the developed detector voltage. This reading should be at least double the previous "residual" reading if the amplification value noted above has been met. Let us say the voltage reading for this step is 0.7 volts.

d. With the **MEGA-NODE SR.** ON, turn the COARSE NOISE OUTPUT ADJUSTMENT potentiometer clockwise to give a noise diode DC plate current of 40 ma. Let us say the output voltage measures 1.3 volts on the V.T.V.M.

e. Turn the COARSE INCREASE control down to give a noise diode DC plate current of 20 ma. and read the 2nd detector V.T.V.M. Let us say this reading is 1.0 volt.

f. Subtract the 0.3 volt "residual" reading of step *b* from each of the subsequent readings (steps *c*, *d*, and *e*). This gives readings of 0.4, 1.0 and 0.7 volts, respectively.

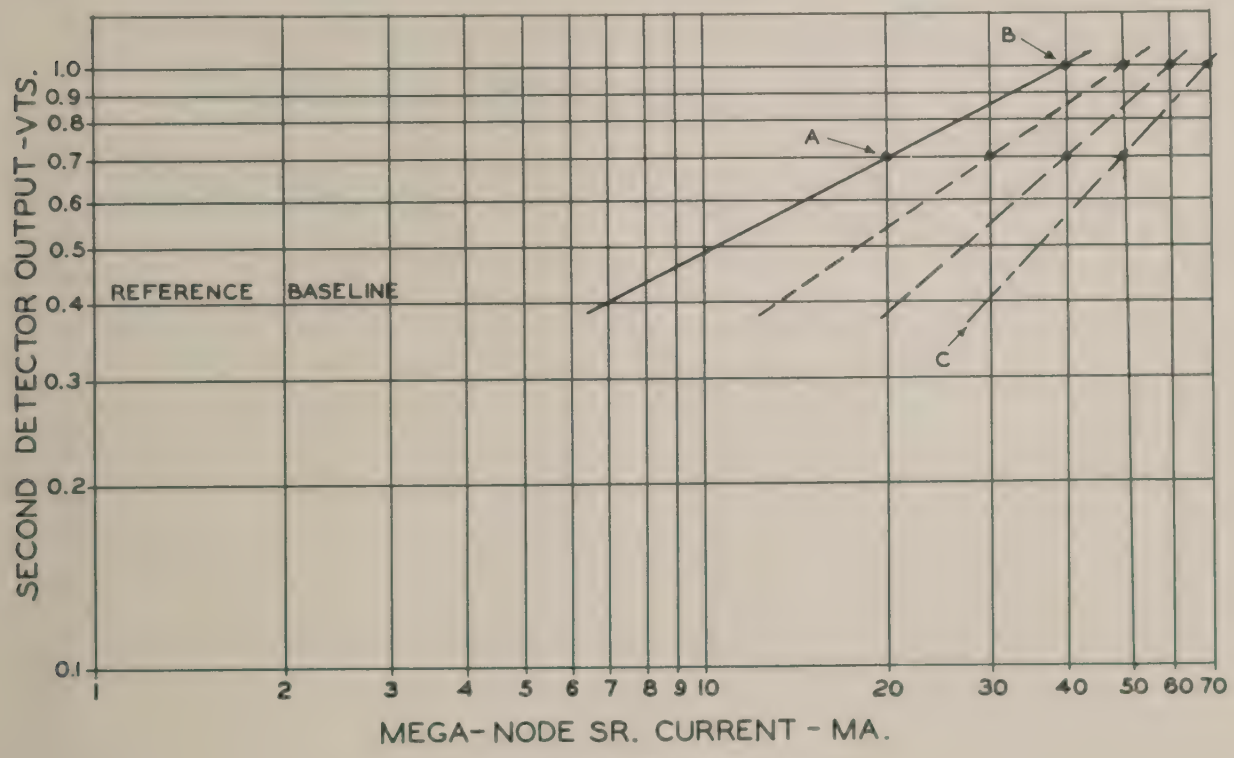
g. Using log-log graph paper with **MEGA-NODE SR.** current as the abscissa and 2nd detector voltage as the ordinate, plot a horizontal line at the 0.4 volt level as a reference base line, and plot the 0.7 volts, 20 ma., point and the 1.0 volt, 40 ma., point as shown at A and B respectively in *Figure 6*.

h. The problem is to find now by graphical trial-and-error and incremental noise diode current value which, when added equally to points A and B, yields a new pair of points, a straight line through which then intersects the REFERENCE BASE LINE at a current value exactly equal to the incremental current value.

i. Let us first try an incremental current value of 10 ma. When this value is added equally to points A and B, we get two new points (0.7 volt, 30 ma. and 1.0 volt, 50 ma.). A straight line intersects the REFERENCE BASE LINE at about 13.4 ma., which is larger than the chosen incremental value. This indicates that a larger incremental value should be tried.

j. Trying an increment of 20 ma., we get points 0.7 volt, 40 ma. and 1.0 volt, 60 ma. A straight line through these points (the long-dashed line in *Figure 6*) produces an intercept at about 21.5 ma. A still larger incremental value must hence be chosen.

k. Trying an increment of 29 ma., we get points 0.7 volt, 49 ma., and 1.0 volt, 69 ma. A straight line through these points (the long-short dashed line in *Figure 6*) intersects the REFERENCE BASE LINE at exactly 29 ma., corresponding to the incremental value chosen. This is the correct value of noise diode current to use in calculating the Noise Figure of the device under test. At the same time, the slope of the final plotted line directly gives the rectifier power law of the second detector used in the set-up when it is noted that this final line is essentially that of rectified detector output voltage versus total noise power applied to the detector. A 45 degree slope (i.e., tan = 1) would thus indicate that the detector was of the so-called "square law" type, while a 26.6 degree slope (i.e., tan = 0.5) would indicate a linear detector.



NOISE MEASUREMENT

Figure 6. Log-Log Graphical Noise Measurement.

5. CORRECTION FOR SUPERHETERODYNE RECEIVER. In measuring the Noise Figure of a superheterodyne receiver, a correction must be applied to the current reading obtained. Since the MEGA-NODE SR. produces noise at both the signal and the image frequencies, the correction factor must be such as to give the DC generator current that doubles the noise output power if there had been no image response. If A and B are the average power gains at signal and image frequencies, respectively, the multiplying factor is:

$$\frac{A}{A - B}$$

SECTION IV
THEORY OF OPERATION

A. NOISE MEASUREMENT THEORY.

The "noise diode" method of measuring receiver Noise Figures is quite fundamental and permits simplification in procedure and greater accuracy than other methods. Techniques employing a continuous-wave signal generator are subject to a noticeable error in the measurement of the extremely small power levels employed, especially at the higher frequencies, and a separate measurement of receiver bandwidth is required. The use of a temperature-limited diode as a noise generator permits cancellation of the bandwidths involved, since the diode noise is distributed the same as the receiver noise with respect to frequency. This method, hence, requires no measurements nor knowledge of bandwidth or gain. The mean squared noise current supplied by the diode is proportional to the d-c plate current which can be easily and accurately measured.

1. NOISE FIGURE MEASUREMENTS. Any receiver, other than a hypothetical ideal receiver, will have noise generated within the receiver itself in addition to the noise supplied by the signal source. The Noise Figure is a figure of merit by which the noise of a given receiver system is compared with that of an ideal receiver in a similar system but having the same bandwidth. The noise supplied to the ideal receiver by the signal source will be

$$e_t^2 = 4KTR_a\Delta f \qquad (1)$$

Where:

e_t^2 = Open-circuited mean squared thermal noise voltage.

K = Boltzmann's constant, 1.37×10^{-23} joules/°K.

T = Temperature of resistance in °K.

R_a = Internal resistance of the source in Ω.

Δf = Receiver noise bandwidth in cps.

The noise present in the given receiver will be that supplied by the signal source plus the noise generated within the receiver itself. The noise generated within the receiver may be referred to the signal source as a mean squared noise voltage. Call this voltage e_n^2.

Then by definition:

$$\text{Noise Figure} = F = \frac{e_n^2}{e_t^2} \qquad (2)$$

To determine e_n^2 the "noise diode" is connected to the receiver through the signal source impedance, R_a. With the noise source turned off, the noise power output of the receiver is measured. Then the noise source is turned on and the diode direct plate current is increased from its lowest value to that value which just doubles the receiver noise power output. The mean squared noise current of the diode is given by

$$i^2 = 2eI_b\Delta f \qquad (3)$$

Where:

i = Root mean squared noise current in amps.

e = Charge on electron (1.59×10^{-19} coulombs).

I_b = DC diode plate current in amperes.

Δf = The noise bandwidth of the receiver in cps.

The mean squared voltage developed by this noise current across the internal impedance of the source (R_a) will be

$$e_n^2 = (iR_a)^2 = 2eI_b \Delta f Ra^2 \qquad (4)$$

Substituting equations (1) and (4) in equation (2)

$$F = \frac{eI_bR_a}{2KT} \qquad (5)$$

It is usually permissible to assume T to be room temperature; i.e., 288° Kelvin, 17°C., 63°F., in which case equation (5) reduces to:

$$F = 20I_bR_a \qquad (6)$$

Variation of this reference temperature between 270°K and 300°K ordinarily will affect the Noise Figure by less than about ±5%, which is equivalent to ±0.2 db. The value of F given by (6) is a power ratio. It may be expressed in db by the relationship:

$$F_{db} = 10 \log_{10} F \qquad (7)$$

2. REQUIREMENTS OF THE 'NOISE DIODE' GENERATOR.

a. Resistor R_a, which is taken as the internal impedance of the signal source, must be constant over the noise bandwidth of the unit under test.

b. The "Noise Diode" must be fully temperature limited. This is a condition of equation (3) and it is well to observe that the a-c plate resistance of the diode, which shunts R_a, is sufficiently high to be negligible only when the diode is completely temperature limited. This condition is met in the **MEGA-NODE SR.** for all values of diode d-c plate current less than 100 ma.

B. MEGA-NODE SR. CIRCUIT DESCRIPTION.

The **MEGA-NODE SR.** is basically comprised of a diode, TT-1, random noise generator. All other circuits in the unit function to supply and control the filament and plate potentials for the diode.

1. CONTROL CIRCUIT. The a-c line voltage is fed through *F-1* to *S-2*, the OPERATE switch. This momentary contact switch, when depressed, completes the a-c supply circuit to the coil of *K-1*. *K-1*, when energized, holds the a-c voltage on through *K-2* and *S-4a*. 117 volts is supplied to the primary of *T-1* and *T-2*.

2. DIODE FILAMENT SUPPLY CIRCUITS. The 117V output of *T-1*, the filament voltage regulating transformer, is fed through *S-4b*, *R-9*, *R-10*, *R-8* and *R-7* to *T-2*, the filament transformer. *R-9* functions as an internal output level adjustment for the low range. *R-7* functions as an internal output level adjustment for the high range. The secondary of *T-2* supplies filament voltage for the TT-1 through the output of a balanced bridge selenium rectifier circuit, *CR-1* and *Cr-2* to *C-1*, *R-1* and *R-2*, internal adjustments for the TT-1 filament supply. The setting of *R-6* determines the voltage applied to the heater of *K-2*, the thermal time delay relay.

3. PLATE VOLTAGE SUPPLY CIRCUIT. The B^+ supply is taken from a power supply from the output of *T-3* and *V-1*. This power supply provides good regulation of the B^+ applied to the TT-1 through *S-4c*.

The positive d-c voltage is fed through *S-4c*, the plate current metering circuit, and *R-15* and *F-2* to the noise diode plate. *F-2* provides overload protection for the diode. A shunt multiplier is connected across the meter circuit by *S-4c* when in the high output position. This shunt, comprised of *R-12* and *R-13*, provides a meter scale multiplication of 10.

SECTION V
MAINTENANCE

WARNING

The MEGA-NODE SR. contains voltages in excess of 500 volts. Exercise extreme caution when performing maintenance on this equipment.

A. INTERNAL ADJUSTMENTS.

The following chassis adjustments, although factory-set, may require attention after diode aging, component replacement, etc. The following procedure should be used in setting these controls.

1. **PRESET HIGH** *(R-7)*. This control should be set to provide a slightly more than full-scale reading on the panel meter when the COARSE and FINE NOISE OUTPUT ADJUSTMENTS are fully clockwise and the OUTPUT INDICATOR switch is in the ADD 10 DB position.

2. **PRESET LOW** *(R-9)*. This control should be adjusted with the OUTPUT INDICATOR switch *(S-4)* in the READ METER position. Adjust *R-9* for a slightly more than full-scale panel meter deflection when the COARSE and FINE NOISE OUTPUT ADJUSTMENTS are fully clockwise.

3. **TIME DELAY ADJUSTMENT** *(R-6)*. This control determines the operation time of the unit. Adjust *R-6* for a 30 second operating cycle. Set the OUTPUT INDICATOR switch in ADD 10 DB position and NOISE OUTPUT ADJUSTMENTS for a full-scale meter reading (100 ma.) before adjusting *R-6*.

4. **METER MULTIPLIER ADJUSTMENT** *(R-13)*. This control is initially factory-set (and soldered in place) for the correct meter calibration. Should any component in the meter circuit be replaced, unsolder and reset *R-13* for the correct meter calibration in the ADD 10 DB position. An external 0-100 ma. d-c meter should be connected in series with the plate supply to the noise diode; the panel meter may be calibrated using the external meter as a standard.

B. TT-1 DIODE REPLACEMENT *(Refer to Figure 10)*.

If it becomes necessary to remove and replace the TT-1 diode, proceed in the following manner:

1. Unsolder the filament power lead and ground terminal from the diode assembly. Remove plate lead to diode; remove the front panel and chassis screws holding the diode assembly in place. The diode assembly may now be removed from the chassis.

2. Unsolder the filament connections to the diode. One connection is the inner conductor enameled wire; the other is the outer conductor tubing. *(Be careful not to bend or kink the enameled wire. Note the connections to facilitate re-assembly.)*

3. Carefully withdraw the rear section of the assembly from the TT-1 diode. The filament outer conductor tubing will be exposed.

4. Slide back the filament outer conductor tubing--slide back the insulating spaghetti. The inner conductor enameled wire will then be exposed. A small soldered sleeve connects the filament inner conductor wire to the diode filament connector.

5. Carefully unsolder the inner conductor sleeve and withdraw the enameled wire. (Retain the connecting sleeve.)

6. The opposite end of the diode may be withdrawn from the front section of the assembly. Loosen and slide off cooling vanes.

7. In reassembling with a new TT-1 diode, reverse the above procedure. First put the cooling vanes in place; plug front of diode into front of assembly making certain that a good electrical contact is made with the output connection tubing. Solder inner conductor wire to inner filament conductor of diode, using the sleeve. (Avoid excess solder.) Slip spaghetti over sleeve and slide outer conductor tubing into place. The diode with filament leads in place may now be inserted into the back section of the assembly. Resolder the filament connections.

C. TROUBLE LOCATION.

In case of failure, it is advised to first be sure the difficulty is not with the circuit under test, the auxiliary equipment or interconnecting cables. For location of trouble in the **MEGA-NODE SR.**, the following table should be of aid:

TROUBLE LOCATION CHART	
SYMPTOM	**PROBABLE CAUSE AND CORRECTION**
Equipment fails to operate when OPERATE switch is depressed. Blower does not function.	*S-1* open; *F-1* blown. If new fuse also blows, check *T-1*, *T-2* and blower.
Equipment does not remain in operation after OPERATE switch is released.	Check contacts on *K-1*, *K-2* and *S-4a*.
Zero meter indication. NOISE indicator lamp indicates normally, no output from instrument.	Check TT-1 diode; check diode plate voltage; if zero, check *F-2* and plate supply components. Check *R-15*.
Zero meter indication; NOISE indicator lamp indicates normally. Normal noise output from instrument in ADD 10 DB position. No output in READ METER position.	Check meter and *R-14* for open.
Lower than normal meter indication in either switch position.	Check bridge rectifier components. Check plate supply voltage and secondary voltage of *T-1*. Check *C-1* and *C-2*. Check TT-1 for low emission.

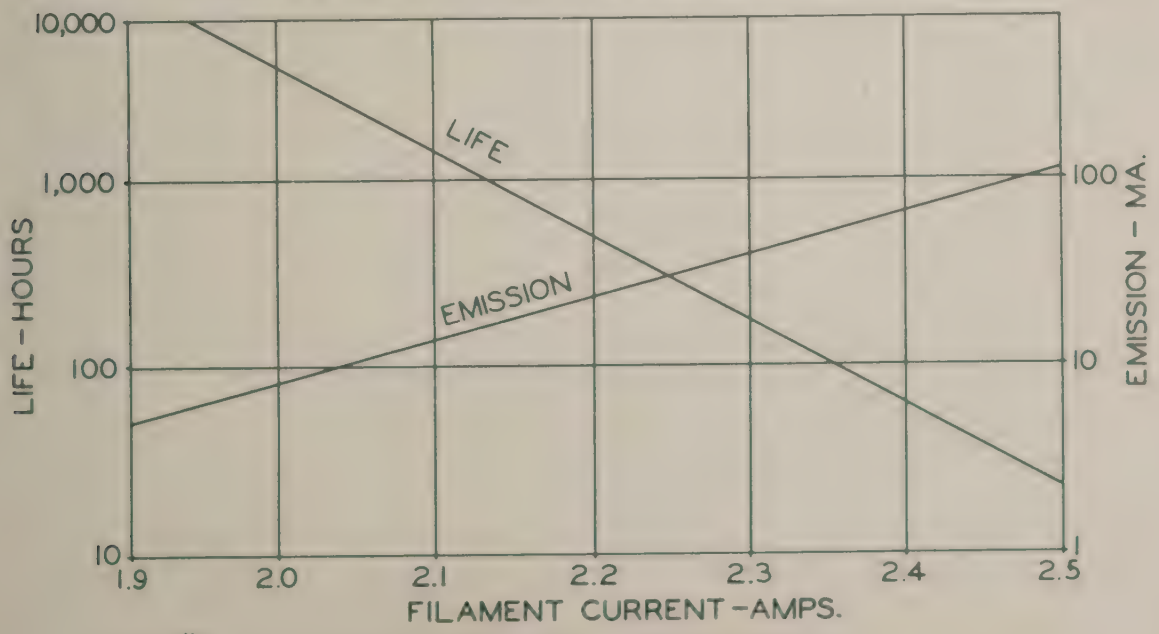


FIG. #7 TT-1 LIFE EXPECTANCY CHART.

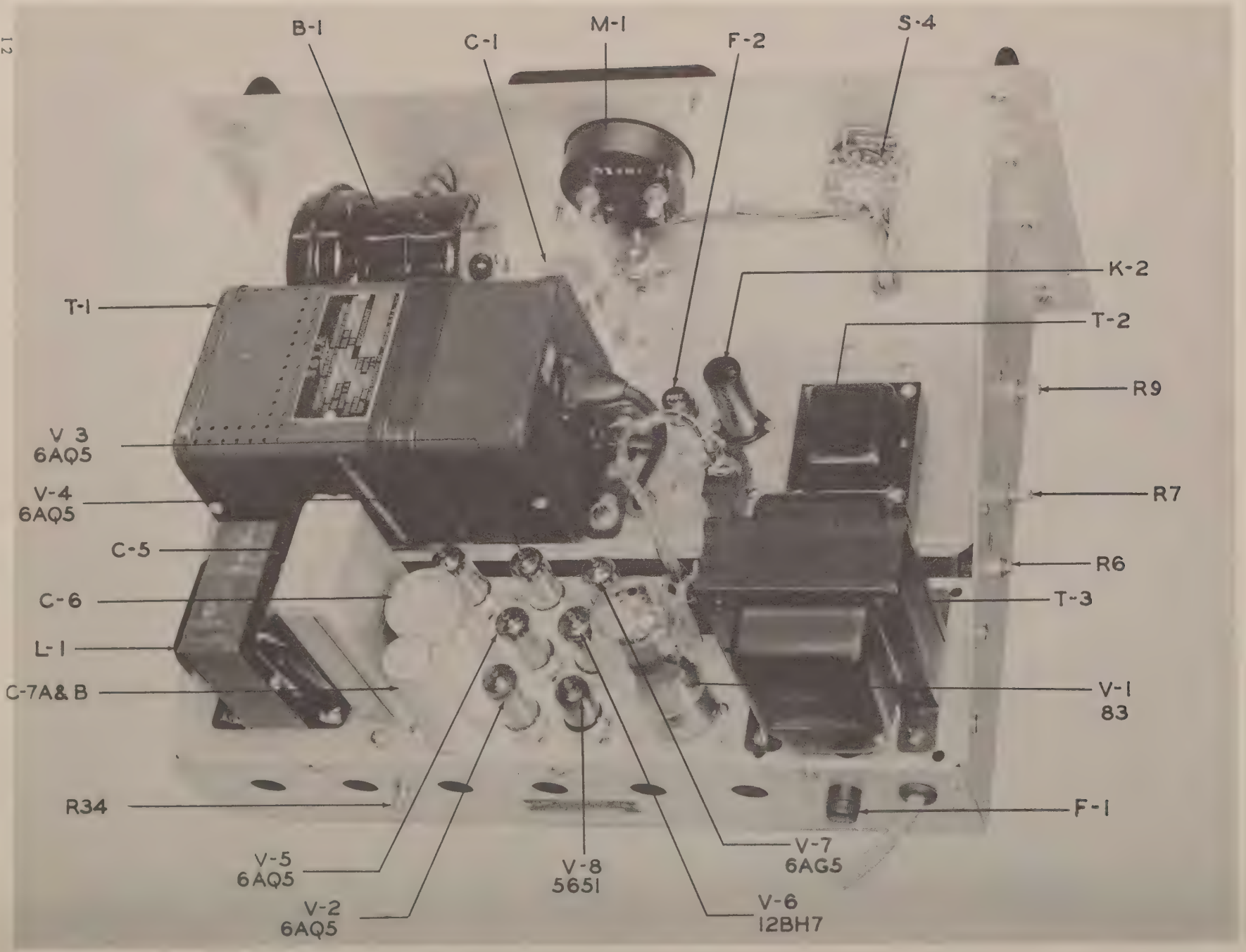


Figure 8. Mega-Node Sr., Top View

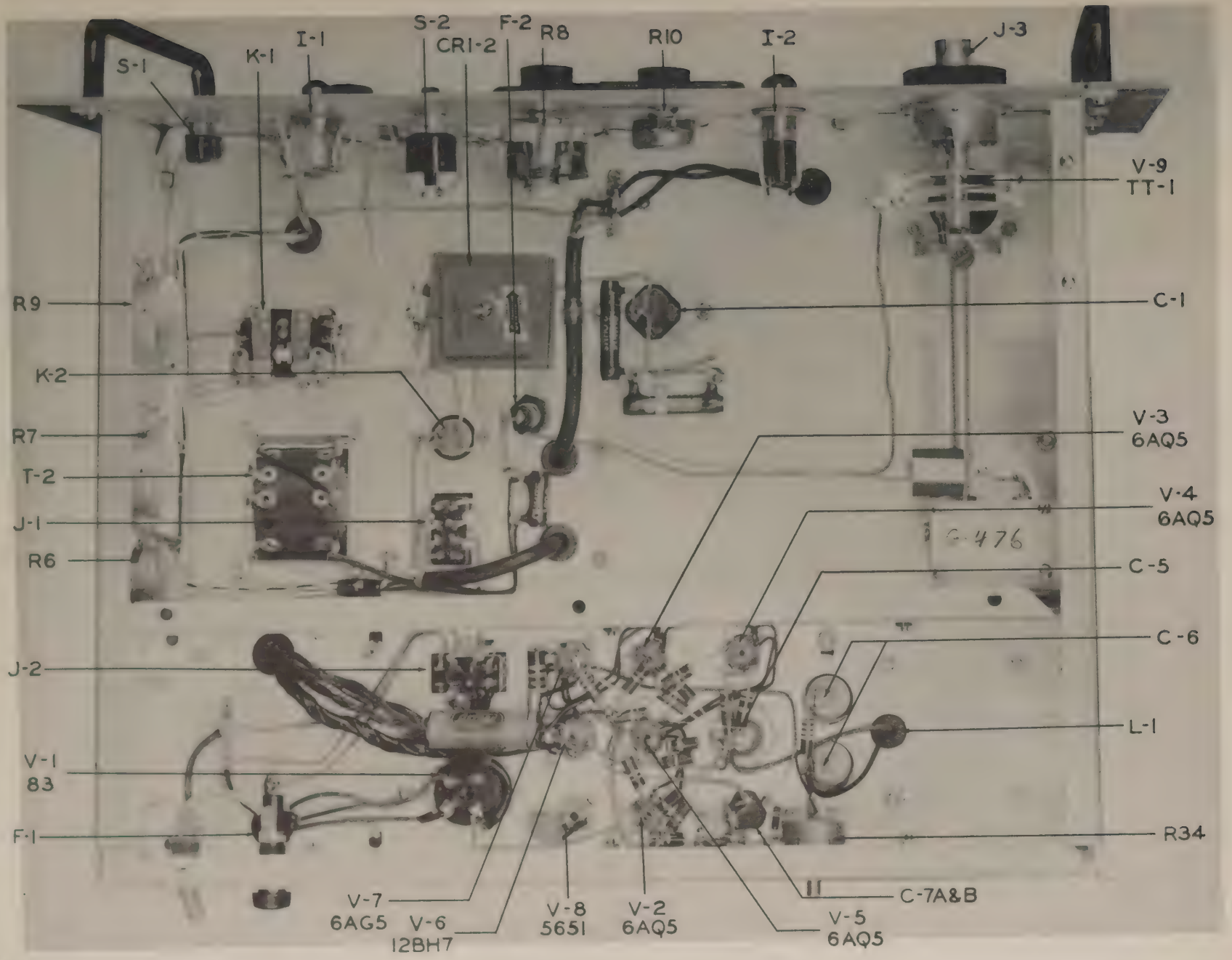


Figure 9. Mega-Node Sr., Bottom View

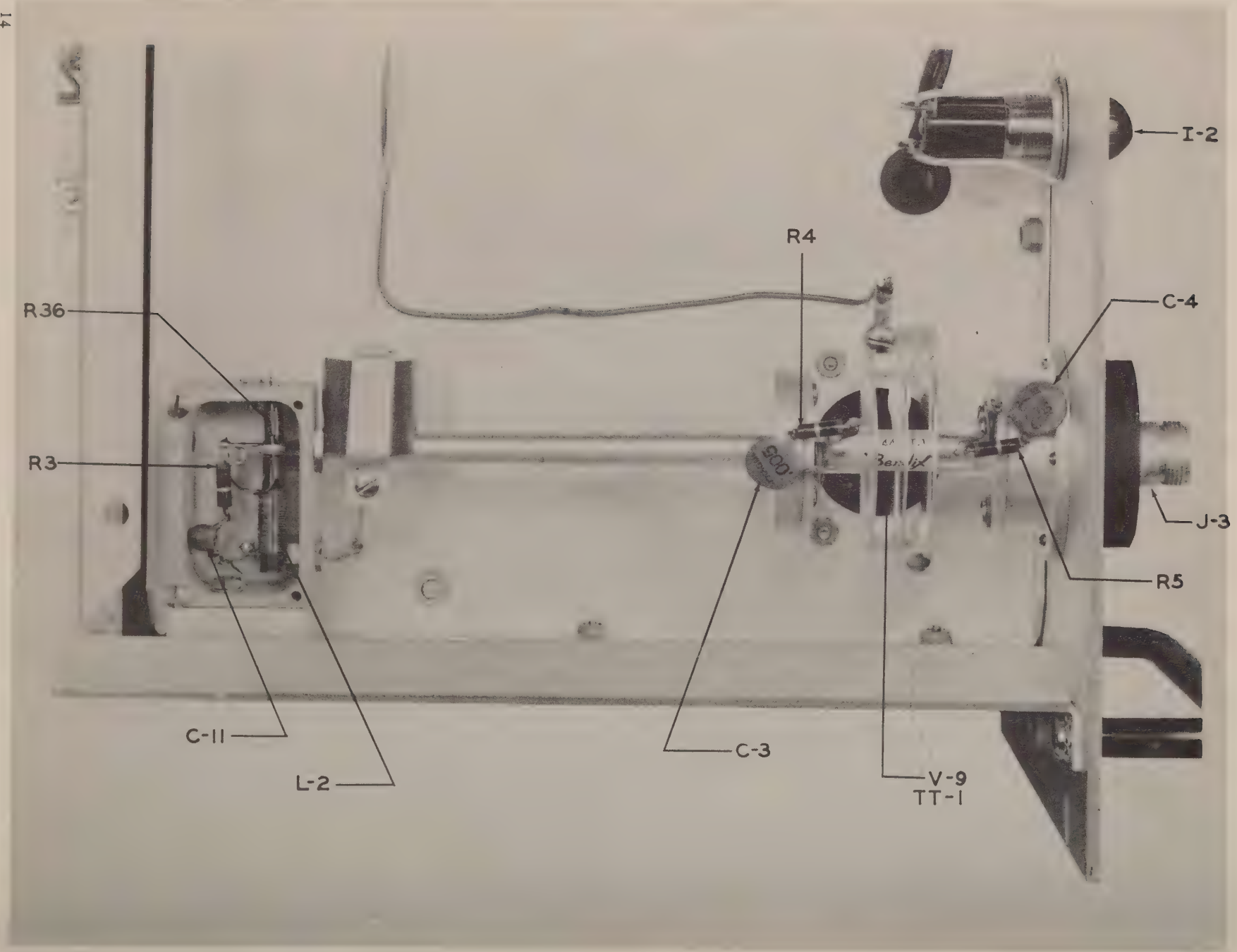
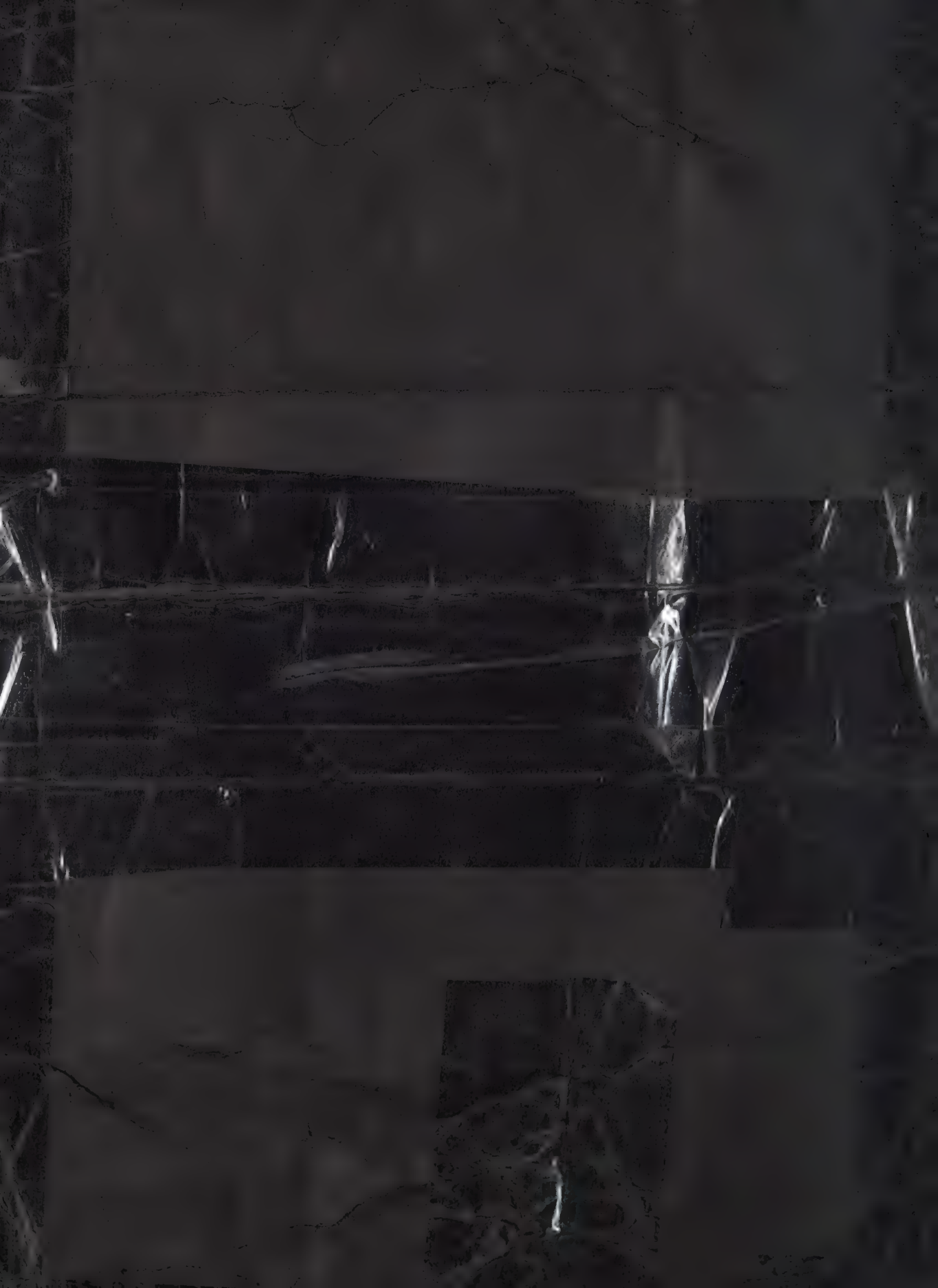
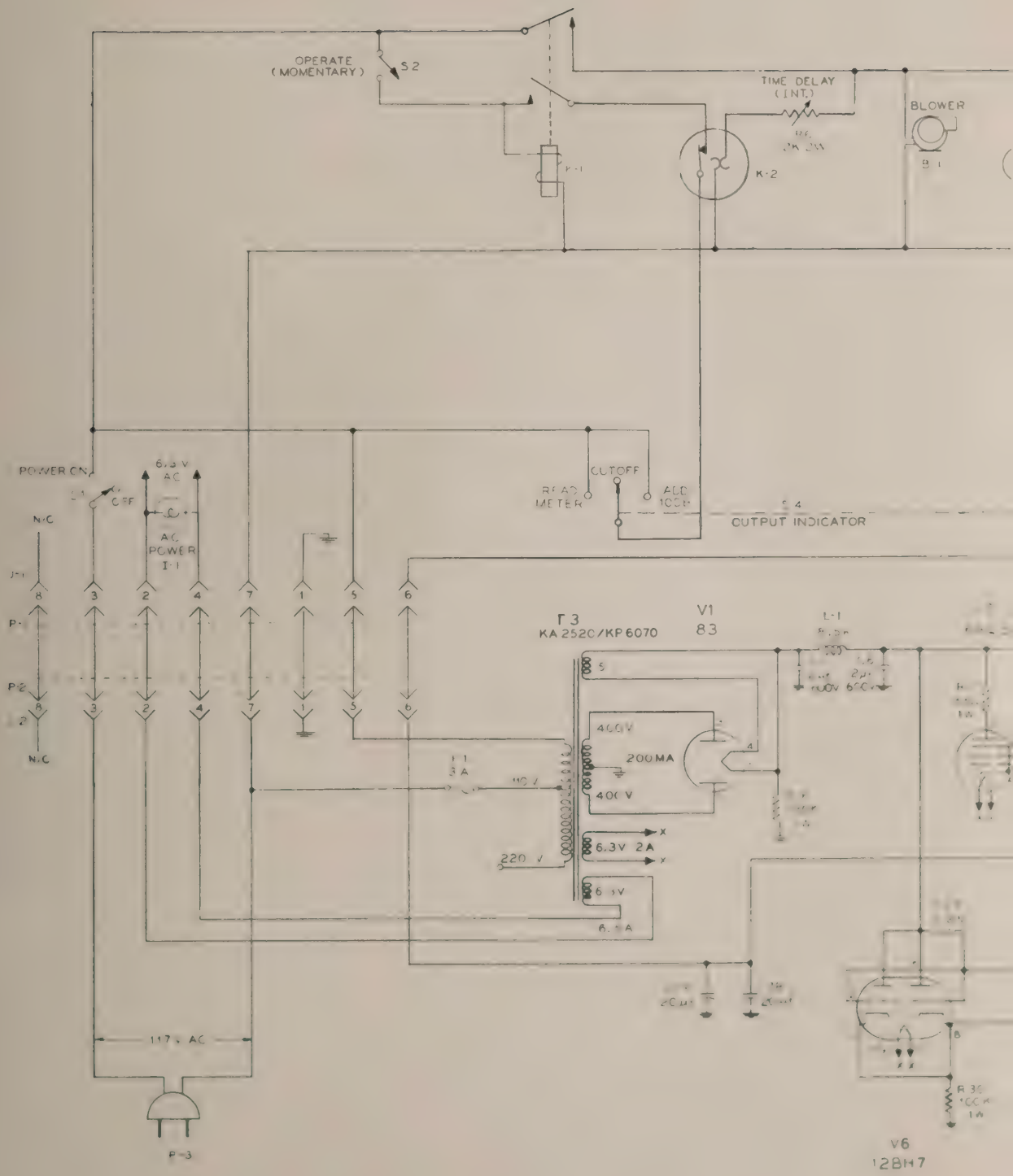
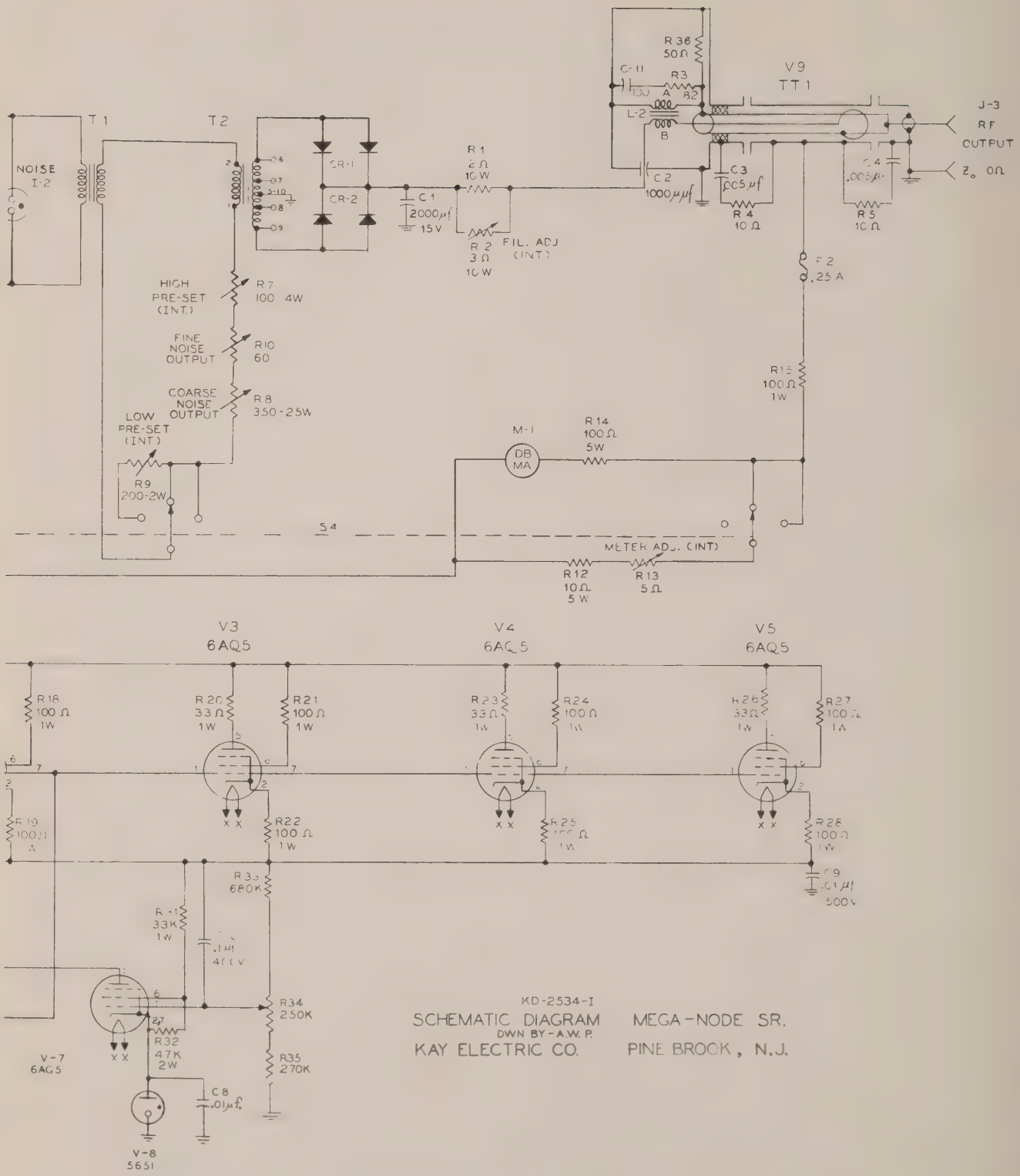


Figure 10. Noise Diode Assembly




OPERATE
(MOMENTARY)
S2
TIME DELAY
(INT.)
BLOWER
K-2
POWER ON
S1
OFF
6.3 V
AC
AC
POWER
I-1
N.C
READ
METER
CUTOFF
ADD
100
S4
OUTPUT INDICATOR
T3
KA 2520/KP 6070
V1
83
400V
200MA
400 V
6.3V 2A
220 V
6.3V
6.3A
117 V AC
P-3
V6
12BH7


T 1
T 2
NOISE
I-2
CR-1
CR-2
C 1
2000μf
15V
R 1
2Ω
10W
R 2
3Ω
10W
FIL. ADJ
(INT)
R 36
50Ω
C-11
R3
A
B2
V 9
TT 1
L-2
B
C 2
1000μμf
C 3
.005μf
R 4
10Ω
C 4
.005μf
R 5
10Ω
J-3
RF
OUTPUT
Z₀ 0Ω
F 2
.25 A
HIGH
PRE-SET
(INT.)
R 7
100 4W
FINE
NOISE
OUTPUT
R10
60
COARSE
NOISE
OUTPUT
R 8
350-25W
LOW
PRE-SET
(INT)
R9
200-2W
R15
100Ω
1W
M-1
DB
MA
R14
100Ω
5W
S4
METER ADJ. (INT)
R12
10Ω
5 W
R13
5Ω
V3
6AQ5
V4
6AQ5
V5
6AQ5
R18
100 Ω
1W
R20
33Ω
1W
R21
100Ω
1W
R23
33Ω
1W
R24
100Ω
1W
R26
33Ω
1W
R27
100Ω
1W
R19
100Ω
A
R22
100 Ω
1W
R25
1W
R28
100Ω
1W
C9
.01μf
500V
R30
680K
R31
33K
1W
.1μf
400V
R34
250K
R32
47K
2W
R35
270K
C8
.01μf
V-7
6AG5
V-8
5651
KD-2534-I
SCHEMATIC DIAGRAM MEGA-NODE SR.
DWN BY-A.W.P.
KAY ELECTRIC CO. PINE BROOK, N.J.

SECTION VI
PARTS LIST

RESISTORS. (UNLESS OTHERWISE SPECIFIED, ALL COMPONENTS ARE FIXED COMPOSITION, ½ WATT, 10% TOLERANCE RESISTORS).

R-1	2; 10W	R-13	POT; 5; METER ADJ.	R-25	100; 1W
R-2	POT; 3; 10W; FIL. ADJ.	R-14	100; 5W	R-26	33; 1W
R-3	82	R-15	100; 1W	R-27	100; 1W
R-4	10	R-16	330K; 1W	R-28	100; 1W
R-5	10	R-17	33; 1W	R-29	2.2M
R-6	POT; 2K; 2W; TIME DELAY SET	R-18	100; 1W	R-30	100K; 1W
R-7	POT; 100; 4W; HIGH PRE-SET	R-19	100; 1W	R-31	33K; 1W
R-8	POT; 350; 25W; COARSE OUTPUT	R-20	33; 1W	R-32	47K; 2W
R-9	POT; 200; 2W; LOW PRE-SET	R-21	100; 1W	R-33	680K
R-10	POT; 60; FINE OUTPUT	R-22	100; 1W	R-34	POT; 250K; B^+ ADJ.
R-11	NOT USED	R-23	33; 1W	R-35	270K
R-12	10; 5W	R-24	100; 1W	R-36	50; 1%

MISCELLANEOUS.

B-1	BLOWER
CR-1	RECTIFIER; SELENIUM; FTR 139C1AX1
CR-2	" " " "
F-1	FUSE; 3 A; BUSS A-C LEVEL
F-2	FUSE; 0.25 A; BUSS B^+
I-1	LAMP; DIAL; 6.3 VAC
I-2	LAMP; NEON; GE NE-51; 115V
J-1	CONNECTOR; CHASSIS; CINCH-JONES S-308-AB
J-2	" " " " "
J-3	CONNECTOR; PANEL; N TYPE UG-58/U OUTPUT
K-1	RELAY; ALLIED TYPE BO-6A
K-2	RELAY; THERMAL; GV TYPE RF-30
L-1	CHOKE; FILTER; 8.5H; STANCOR C-1721
L-2	CHOKE; BIFILAR
M-1	METER; DB & MA; SIMPSON MODEL 29
P-1	CONNECTOR; CABLE; CINCH-JONES P.308-CCT
P-2	" " " " "
P-3	PLUG; A-C LINE
S-1	SWITCH; TOGGLE; SPST; POWER
S-2	SWITCH; PUSHBUTTON; MOMENTARY; OPERATE
S-4	SWITCH; ROTARY; OUTPUT INDICATOR
*T-1	TRANSFORMER; REGULATING; K#4288 - 60 CYCLE
T-2	TRANSFORMER; K#4289
T-3	TRANSFORMER; HV; KA 2520/KP-6070

ELECTRON TUBES.

V-1	83
V-2	6AQ5
V-3	6AQ5
V-4	6AQ5
V-5	6AQ5
V-6	12BH7
V-7	6AG5
V-8	5651
V-9	BENDIX TT-1 (MODIFIED)

CAPACITORS. (ALL CAPACITORS IN $\mu\mu F$ UNLESS OTHERWISE INDICATED).

C-1	2000μF; 15V; DRY ELECTROLYTIC
C-2	1000; 500V; FEED THRU; CERAMIC
C-3	0.005μF; 500V; CERAMIC; DISC
C-4	0.005μF; 500V; CERAMIC; DISC
C-5	6μF; 600V; DRY ELECTROLYTIC
C-6	2μF; 600V; DRY ELECTROLYTIC
C-7	DUAL ELECTROLYTIC; 2 X 20μF; 450V
C-8	0.01μF; 500V; CERAMIC; DISC
C-9	0.01μF; 500V; CERAMIC; DISC
C-10	0.1μF; 400V; MOLDED PAPER
C-11	100; 500V; CERAMIC; DISC

*USE #K-4288-50 REG. TRANSFORMER ON 50 CYCLE INSTRUMENTS

18986